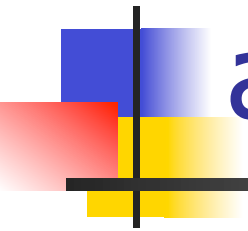
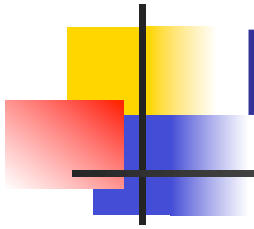
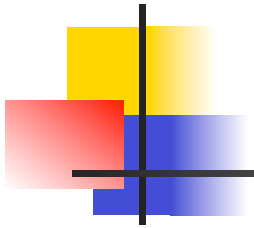


Introduction to sample size and power calculations



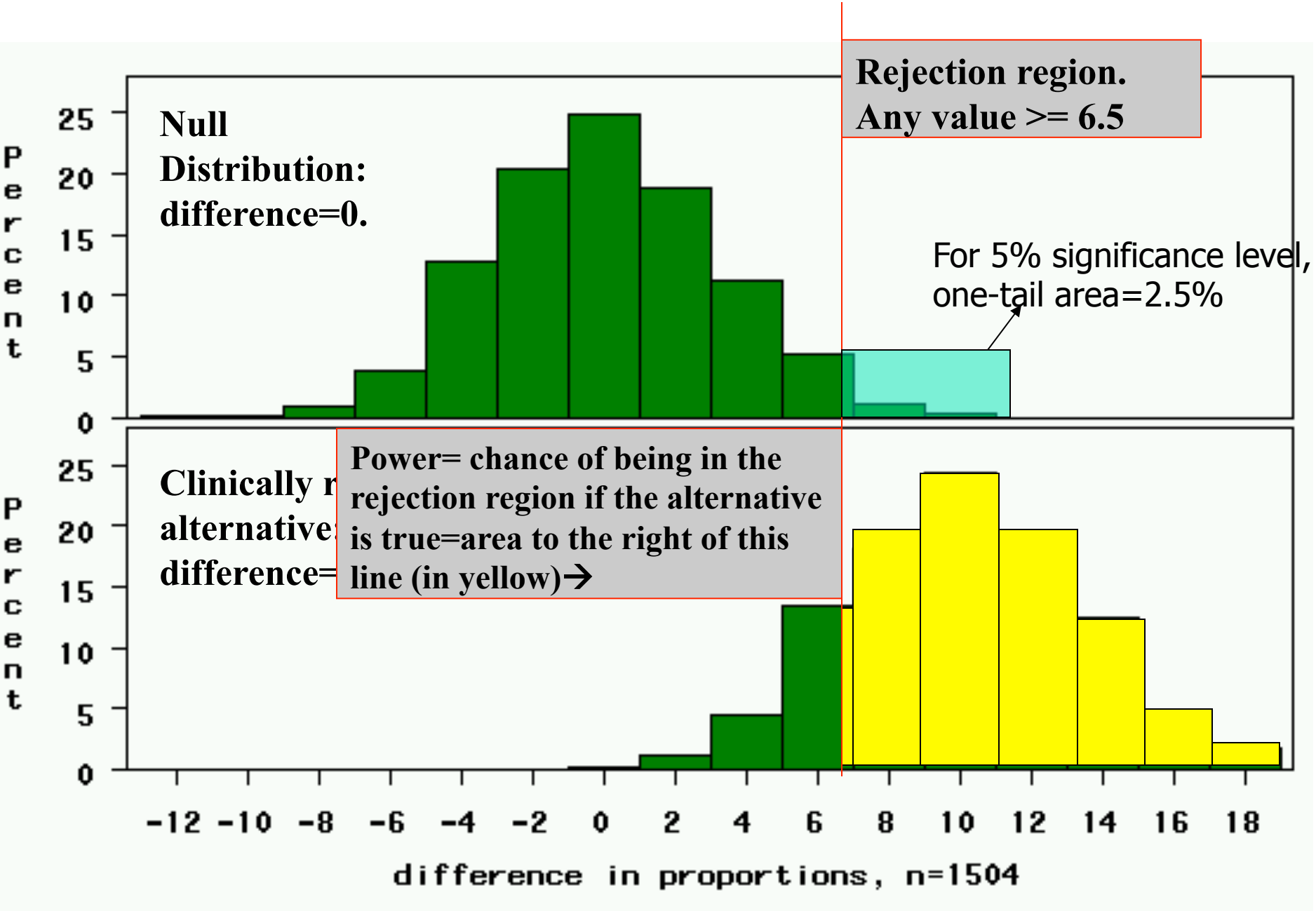
Power

- The probability of rejecting a false null hypothesis (H_0).
- The probability of obtaining a value of t that is large enough to reject H_0 when H_0 is actually false
- We always test the null hypothesis against an alternative/research hypothesis



Can we quantify how much power we have for given sample sizes?

study 1: 263 cases, 1241 controls



study 1: 263 cases, 1241 controls

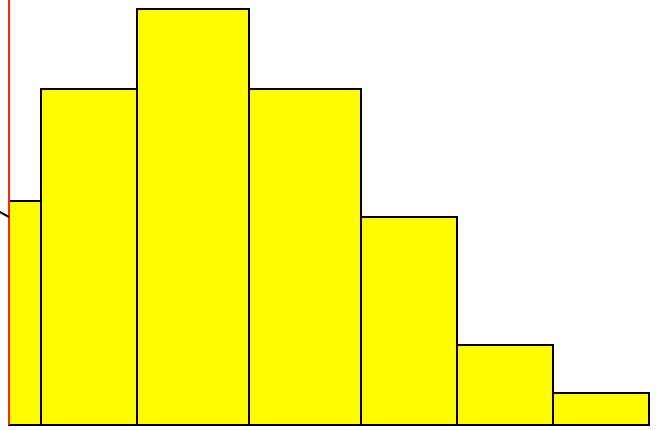
Rejection region.
Any value >= 6.5

Power= chance of being in the rejection region if the alternative is true=area to the right of this line (in yellow)

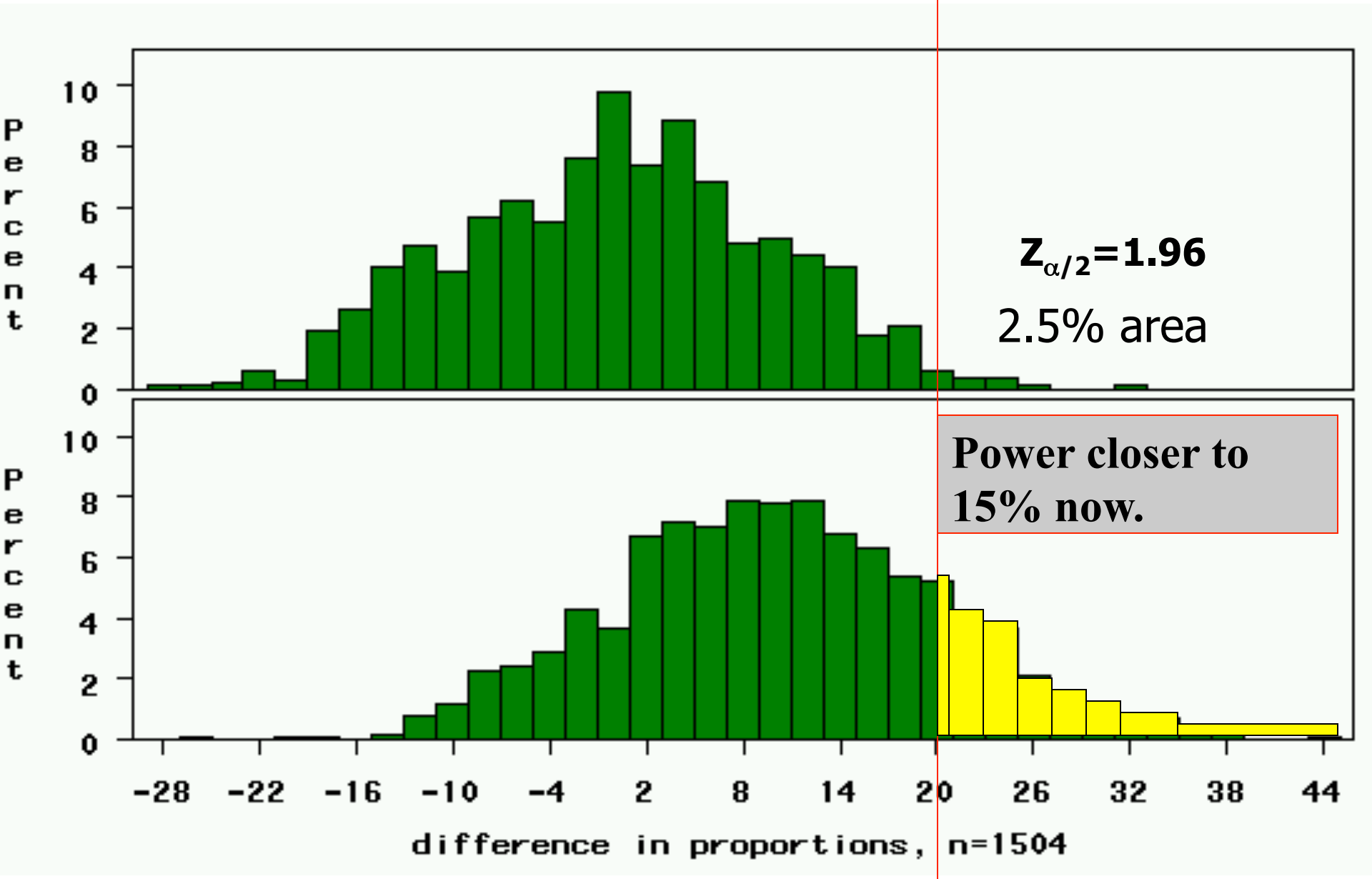
Power here:

$$P(Z > \frac{6.5 - 10}{3.3}) =$$

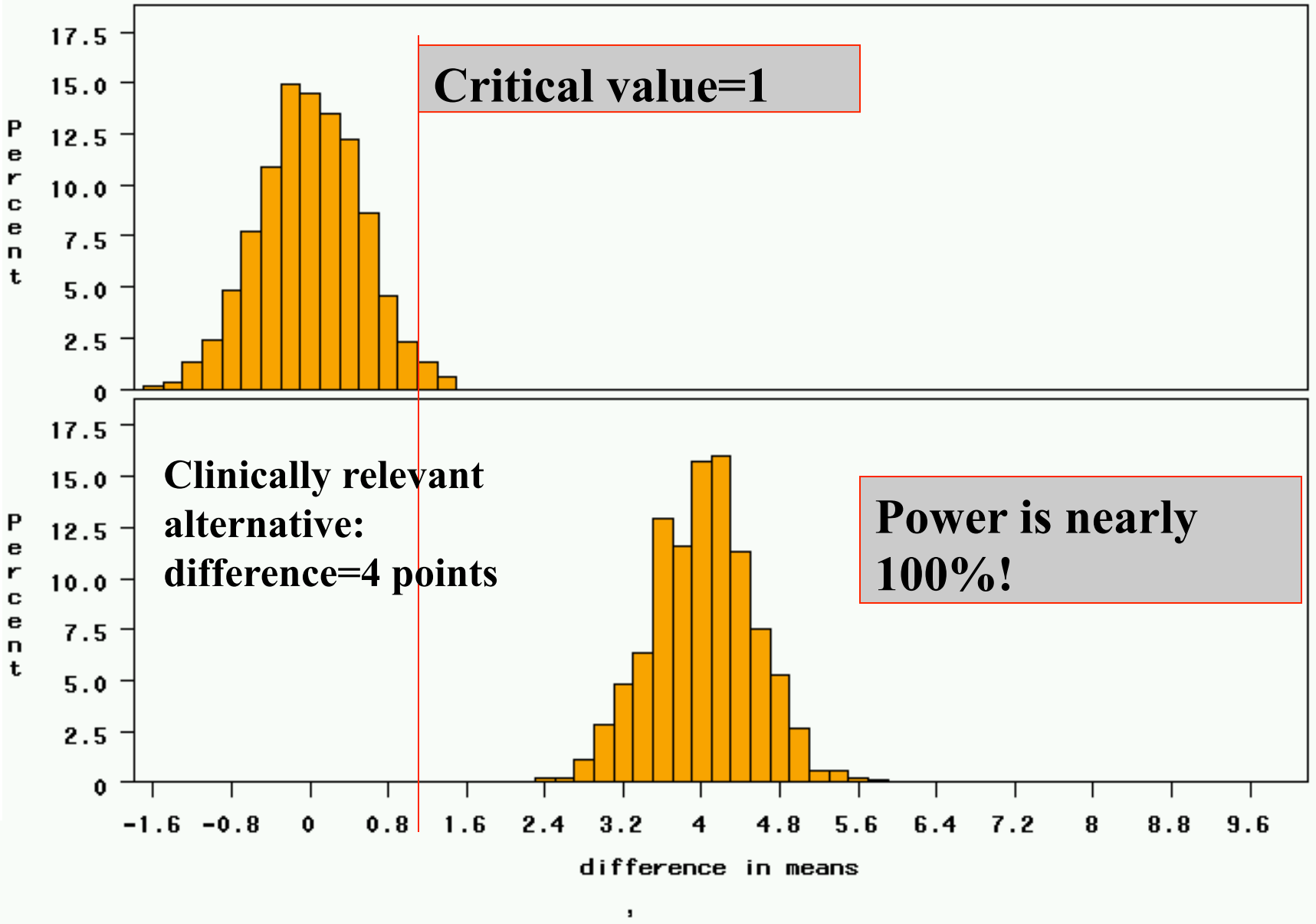
$$P(Z > -1.06) = 85\%$$



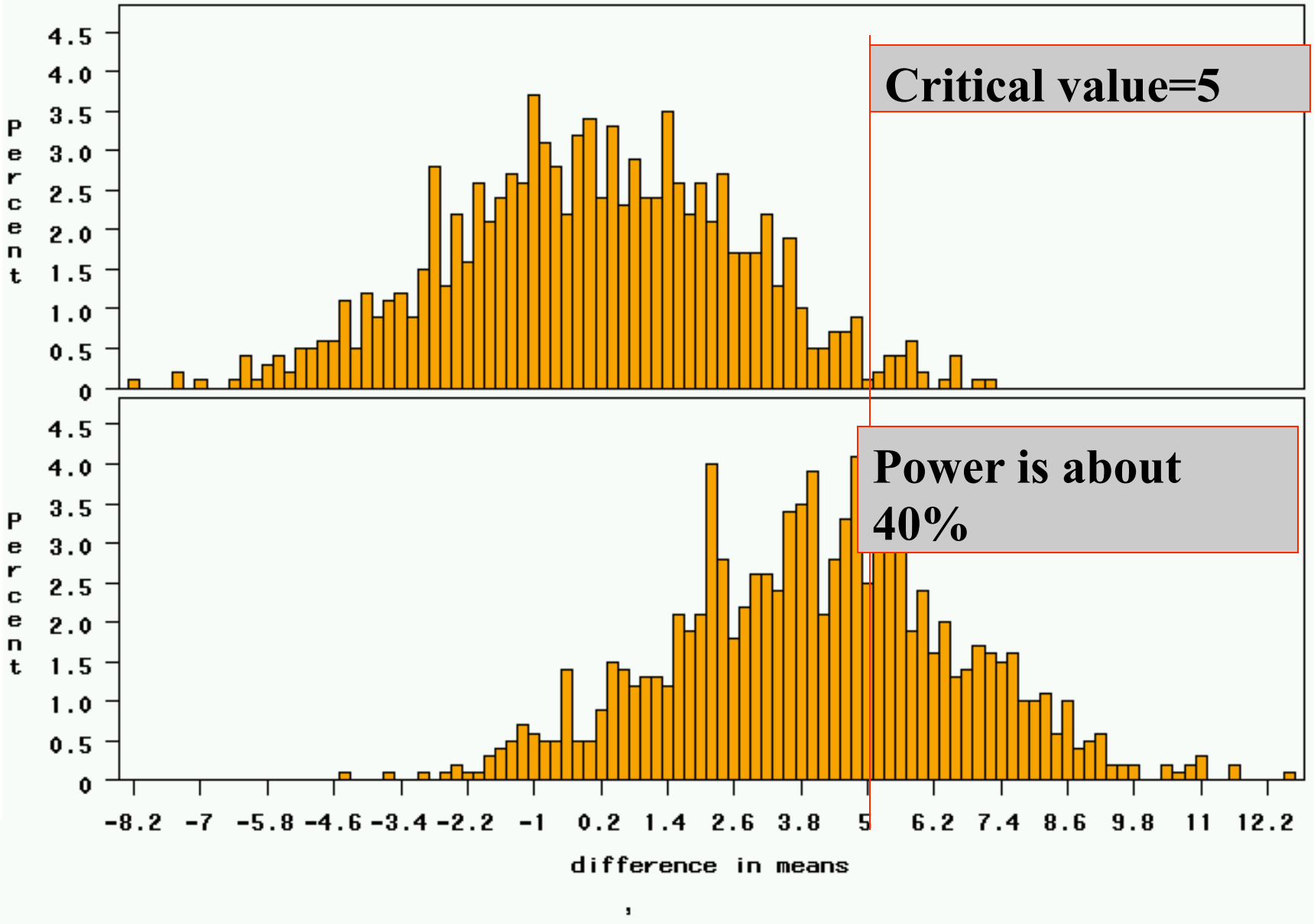
study 1: 50 cases, 50 controls



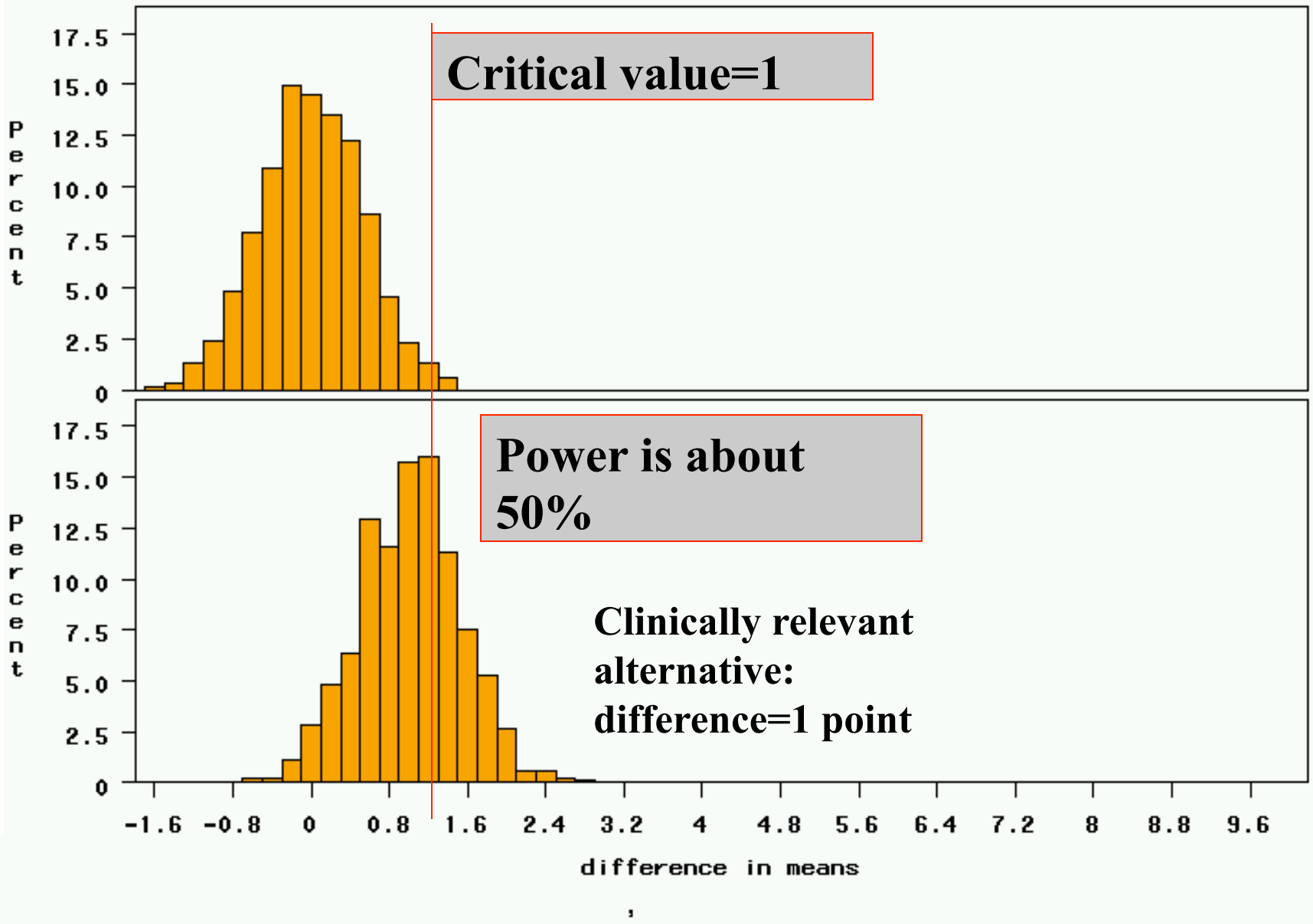
Study 2: 18 treated, 72 controls, STD DEV = 2



Study 2: 18 treated, 72 controls, STD DEV=10



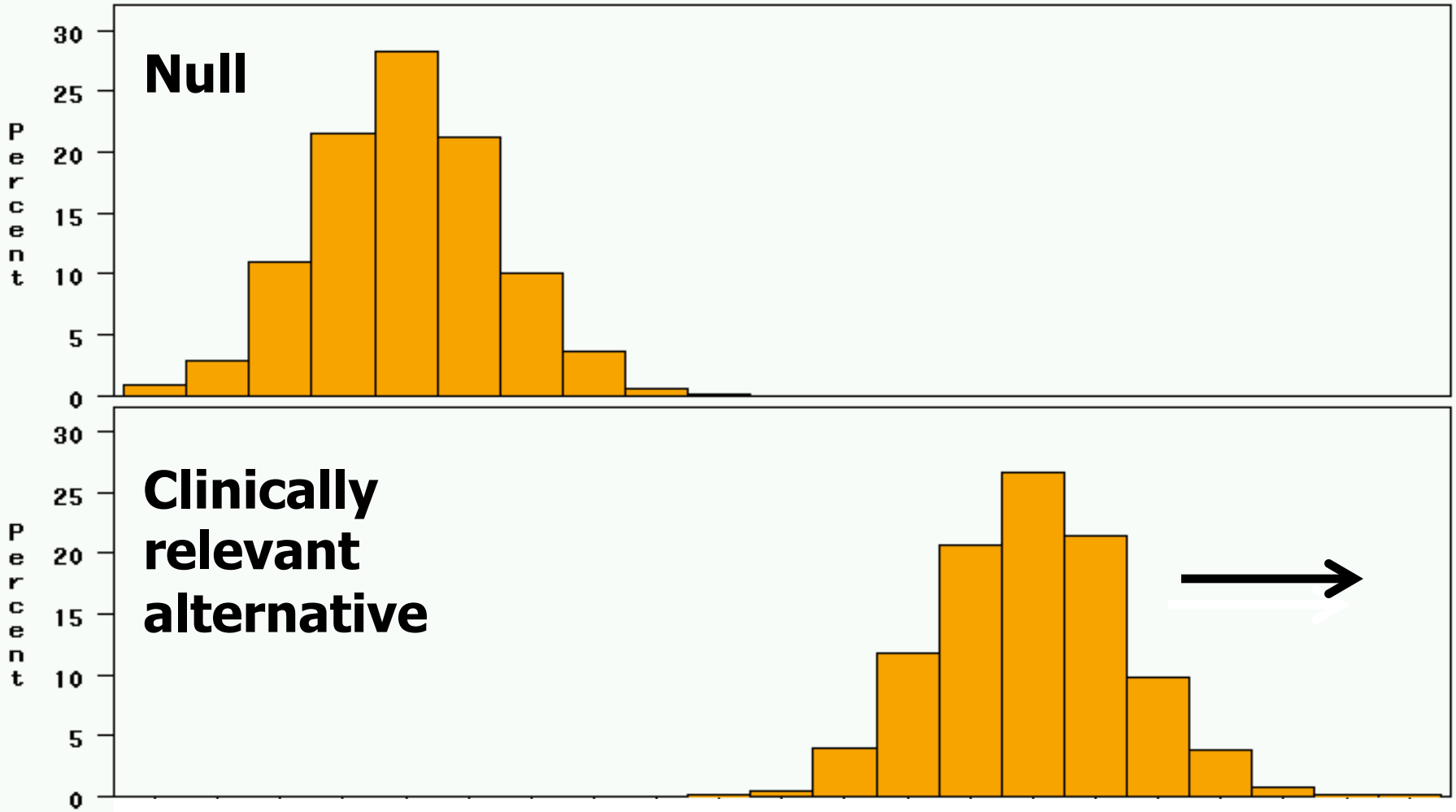
Study 2: 18 treated, 72 controls, **effect size=1.0**



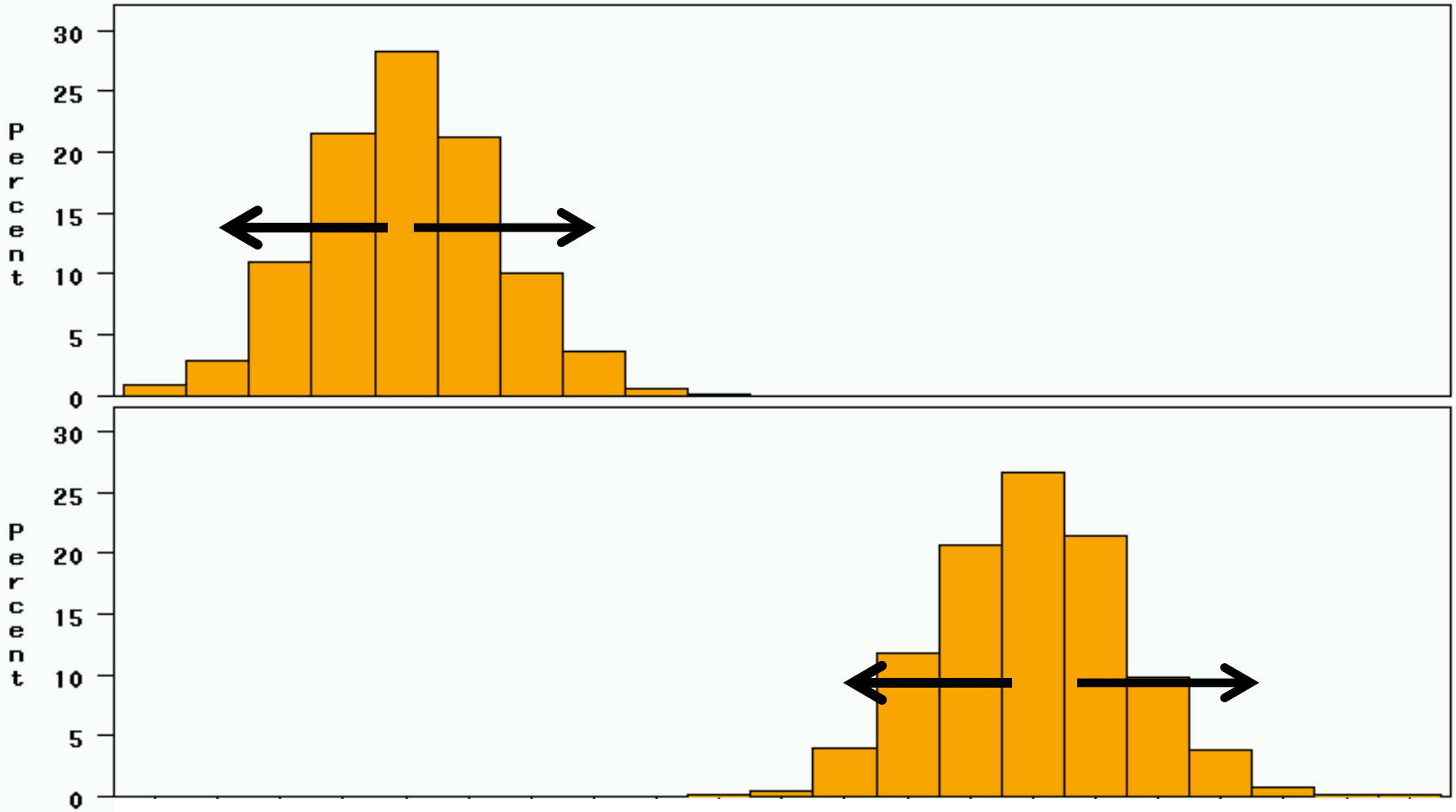
Factors Affecting Power

1. Size of the effect ↑
2. Standard deviation of the characteristic ↓
3. Bigger sample size ↑
4. Significance level desired ↓

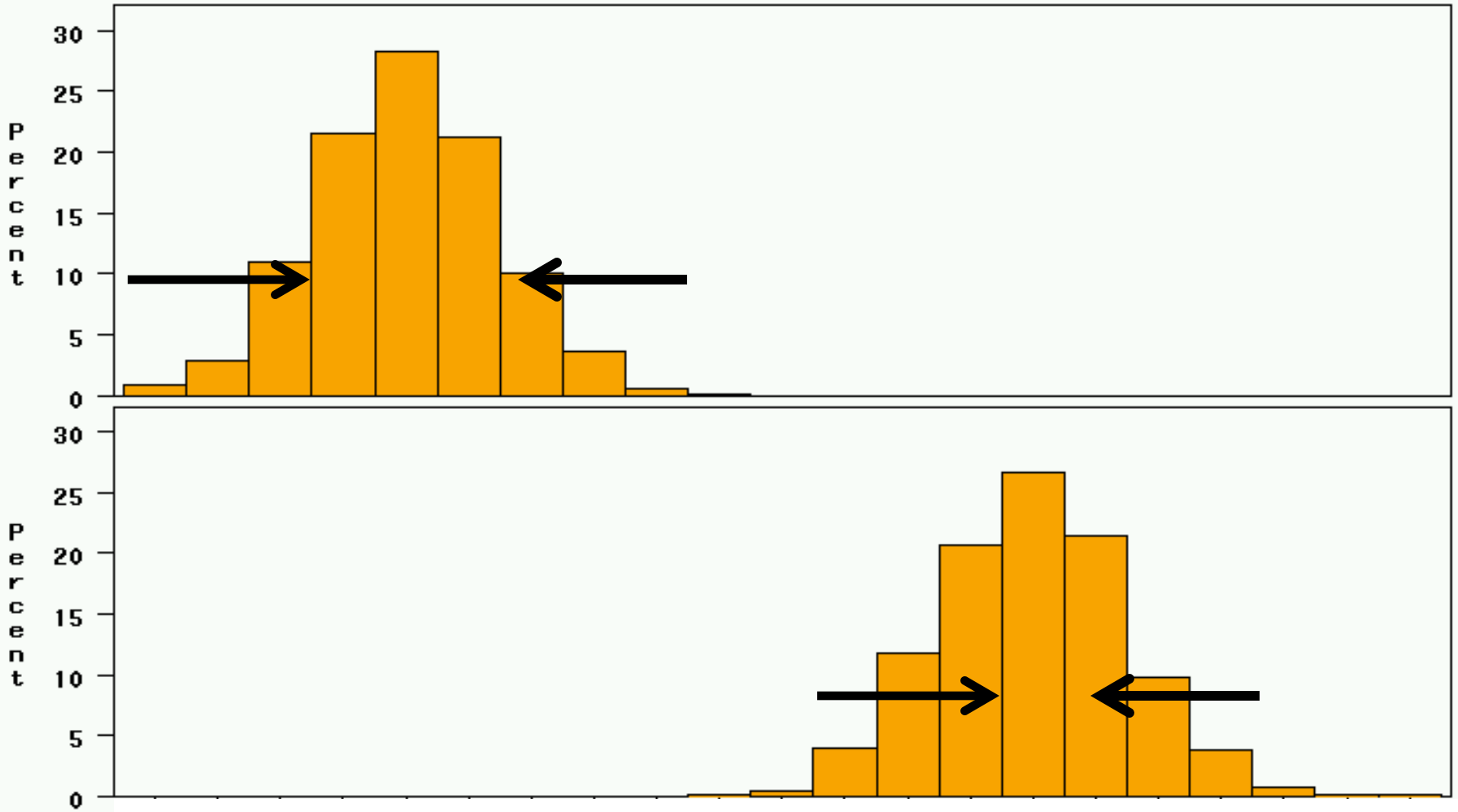
1. Bigger difference from the null mean



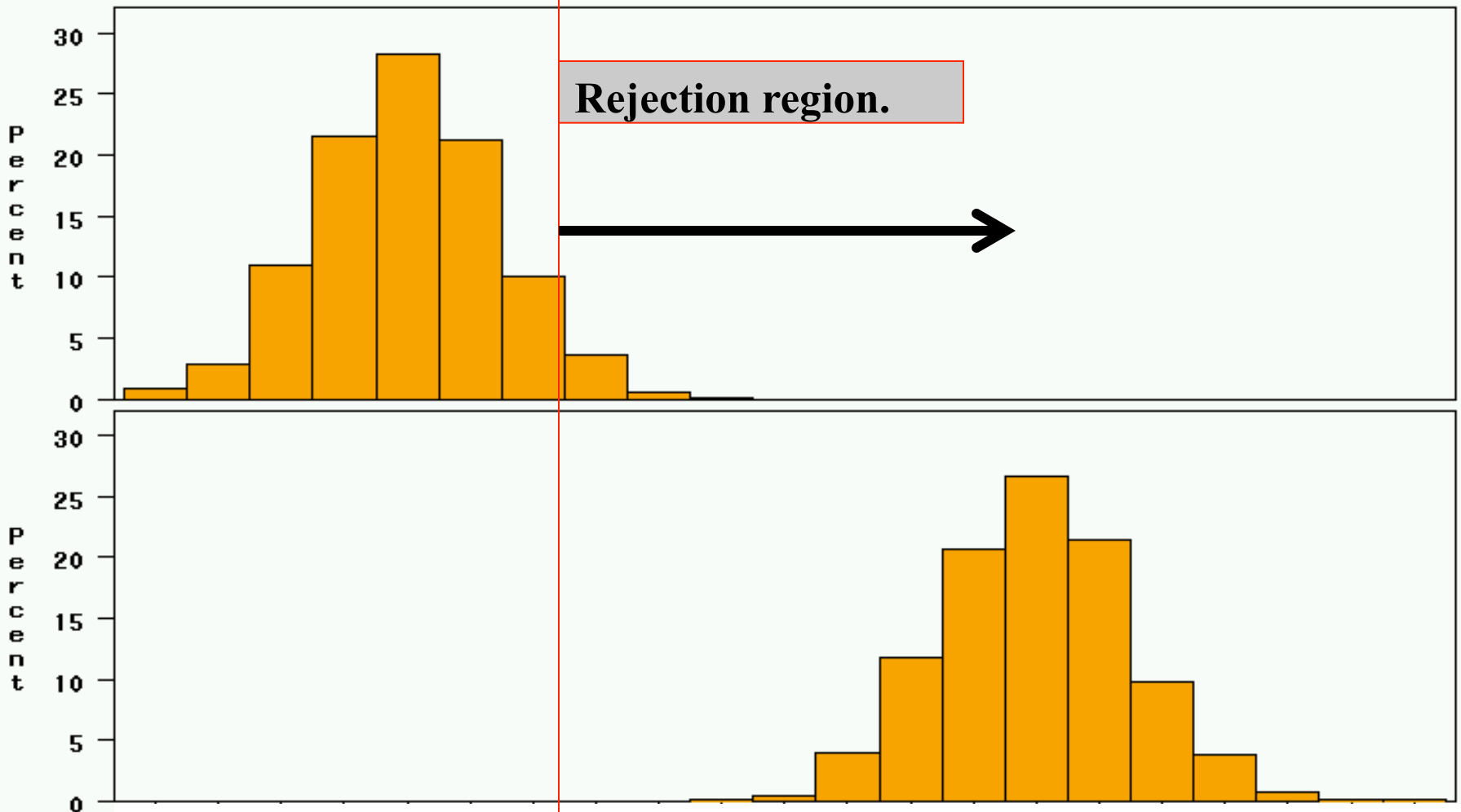
2. Bigger standard deviation



3. Bigger Sample Size



4. Higher significance level



Sample size calculations

- Based on these elements, you can write a formal mathematical equation that relates power, sample size, effect size, standard deviation, and significance level…
- **WE WILL DERIVE THESE FORMULAS FORMALLY SHORTLY**

Simple formula for difference in proportions

Sample size in each group (assumes equal sized groups)

Represents the **desired power** (typically .84 for 80% power).

$$n = \frac{2(\bar{p})(1-\bar{p})(Z_{\beta} + Z_{\alpha/2})^2}{(p_1 - p_2)^2}$$

A measure of **variability** (similar to standard deviation)

Effect Size (the difference in proportions)

Represents the desired **level of statistical significance** (typically 1.96).

- Example: How many people would you need to sample in each group to achieve power of 80%?

$$n = \frac{2\sigma^2 (Z_\beta + Z_{\alpha/2})^2}{(d^*)^2} = \frac{100(2)(.84 + 1.96)^2}{(3)^2} = 174$$

174/group; 348 altogether

In practice

- You need:
  - Alpha level (0.05)
  - Sought power (usually 80%)
  - Standard deviation
    - Estimate based on a pilot study or past literature
  - Effect size!
- https://clincalc.com/stats/samplesize.aspx

Effect size

- Difference between means
- For power, what is the smallest effect size of scientific interest?
  - Ex: Is a 1% decrease in anxiety meaningful? 10%?
  - Ex: Is a 40ms change in reaction time meaningful? 1ms?
- Subjective so be conservative

In class activity

- Calculate the sample size needed to answer
  - Does studying improve test performance?
  - Does playing on your phone while driving increase the number of accidents?
  - Does the treatment decrease anxiety?
- You need to come up with a reasonable standard deviation and effect size.